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STRENGTH AND COMPRESSIBILITY CHARACTERISTICS OF AMORPHOUS TROPICAL PEAT

Akeem Gbenga Amuda [1], Alsidqi Hasan [2*],
Dayang Norfaranina Datu Unoi [3], and Siti Noor Linda [4]

ABSTRACT

Peat is viewed to deflect from the standard guidelines of soil behaviours due to the influence of structural fibres and high compressibility. Hence, the laboratory strength behaviour of peat is often complex, and the geotechnical test results may be doubtful. Amorphous peat is expected to behave differently since the fibres have been broken down into smaller organic contents and humus material. Laboratory tests such as scanning electron microscopy (SEM), one-dimensional (1D) oedometer tests and isotropically consolidated undrained (CIUC) triaxial tests were conducted on amorphous peat samples obtained from a site in Kota-Samarahan, Malaysia. The microstructure of amorphous peat indicates colloidal amorphous-granular particles with no visible evidence of hollow cellular connections. The measured compressibility and strength properties reflect the effect of decomposition and are somewhat different from that of fibrous peat. Interestingly, the strain hardening characteristic which complicates the interpretation of strength results is less significant, and the tension cutoff line is not reached. Based on the outcome of this study, strength and settlement behaviour of amorphous peat can be reasonably measured in the laboratory for design and construction of highways, embankments and other infrastructures.

Key words: Amorphous peat, decomposition, shear strength, microstructure, compressibility, triaxial test.

1. INTRODUCTION

Peat material is majorly composed of organic content from remains of vegetation. It is viewed as one of the most complex geotechnical material due to its high compressibility properties and low strength characteristics as well as heterogeneous behaviour due to a different degree of organic decomposition (De-Guzman and Alfaro 2018; Mesri and Ajlouni 2007). Construction of infrastructures on peat often results in large settlement, long-term creep and sudden catastrophic failures (Boylan *et al.* 2011; Hendry *et al.* 2012). Malaysia falls in the tropical region where peat is found in abundance, and 70% of Malaysia peatlands is in Sarawak, Eastern part of Malaysia. This area coincides with various upcoming infrastructural development such as the Sarawak Corridor of Renewable Energy (SCORE) and the Pan Borneo Highway project (East Malaysia). There is a need to focus greater attention on understanding the properties and mechanical behaviour of peat to prevent unexpected failure and high maintenance of infrastructures. A lot of the research work on peat strength measurement has been carried out on fibrous peat in colder climatic regions. However, a comprehensive database on strength behaviour of amorphous tropical peat is required for adequate material models to aid effective design and construction of infrastructures on peat.

Peat ranges from highly fibrous to amorphous depending on the state and rate of decomposition of the organic content. The ASTM D4427 (2002) classifies peat with a fibre content of less than 20% as amorphous peat. During the period of peat decomposition, the physical plant structure diminishes, chemical state changes and fibres degenerate to smaller organic grains and become more or less equidimensional (Huat *et al.* 2003; Mesri and Ajlouni 2007; Pichan and O'Kelly 2012). The outcome of decomposition is that the fibre content reduces progressively and the hollow cell structures close up (Mesri and Ajlouni 2007). The rate at which peat changes in structure depends on the types of vegetation, climate, available microbes and anthropogenic activities such as farming and drainage control. Given these structural changes in fibre, the geotechnical characteristics of amorphous peat are expected to be different from that of fibrous peat; however extensive research is required to establish the differences (O'Kelly and Pichan 2013; Santagata *et al.* 2008). The microstructure and particle arrangements in peat also change with decomposition (Boelter 1968).

The knowledge of peat microstructure is as essential as the knowledge of material properties in inorganic soils (Hobbs 1986). Geotechnical engineers, more often than not, neglect the investigation of the microstructure for settlement prediction and stability analysis, maybe because it is believed that decomposition does not occur fast enough to change the microstructure within the design life of a geotechnical structure (Hobbs 1986; Pichan and O'Kelly 2012). At present, there is limited research correlating different peat microstructure to their physical and engineering properties (Huat *et al.* 2014).

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[1] Lecturer, Department of Civil Engineering, Nile University of Nigeria, Abuja, Nigeria.
[2*] Senior Lecturer (corresponding author), Department of Civil Engineering, Universiti Malaysia, Sarawak, Malaysia (e-mail: halsidqi@unimas. my).
[3] Graduate student, Department of Civil Engineering, Universiti Malaysia, Sarawak, Malaysia.
[4] Associate Professor, Department of Civil Engineering, Universiti Malaysia, Sarawak, Malaysia.